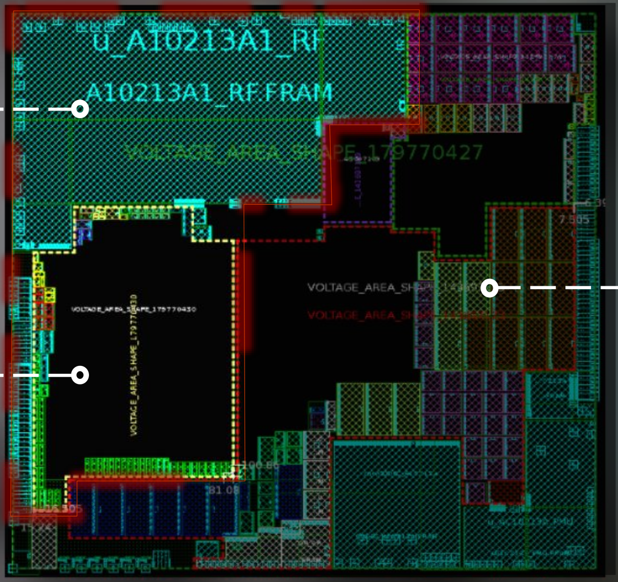
Microsoft

Azure

Securing the Billions of Devices Around Us

Dr. Galen Hunt
Distinguished Engineer and Managing Director
Microsoft Azure Sphere



Radio Analog

2.4 & 5 GHz

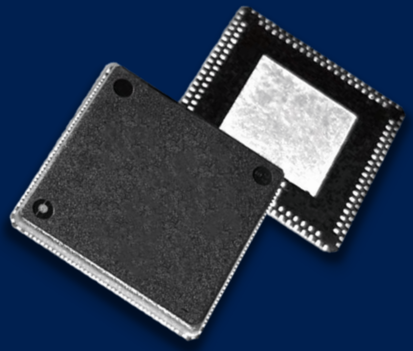
Radio Digital

WiFi

MCU

192Mhz Cortex-M4
256KB SRAM
1MB NOR FLASH
GPIO, I2C, I2S, etc.
RTOS (no kernel)

MCU (Microcontroller)
low-cost, single chip computer



9 BILLION new MCU devices built and deployed every year

Connected devices create profoundly better customer experiences.

How do you know if the compressor in your fridge needs to be replaced?

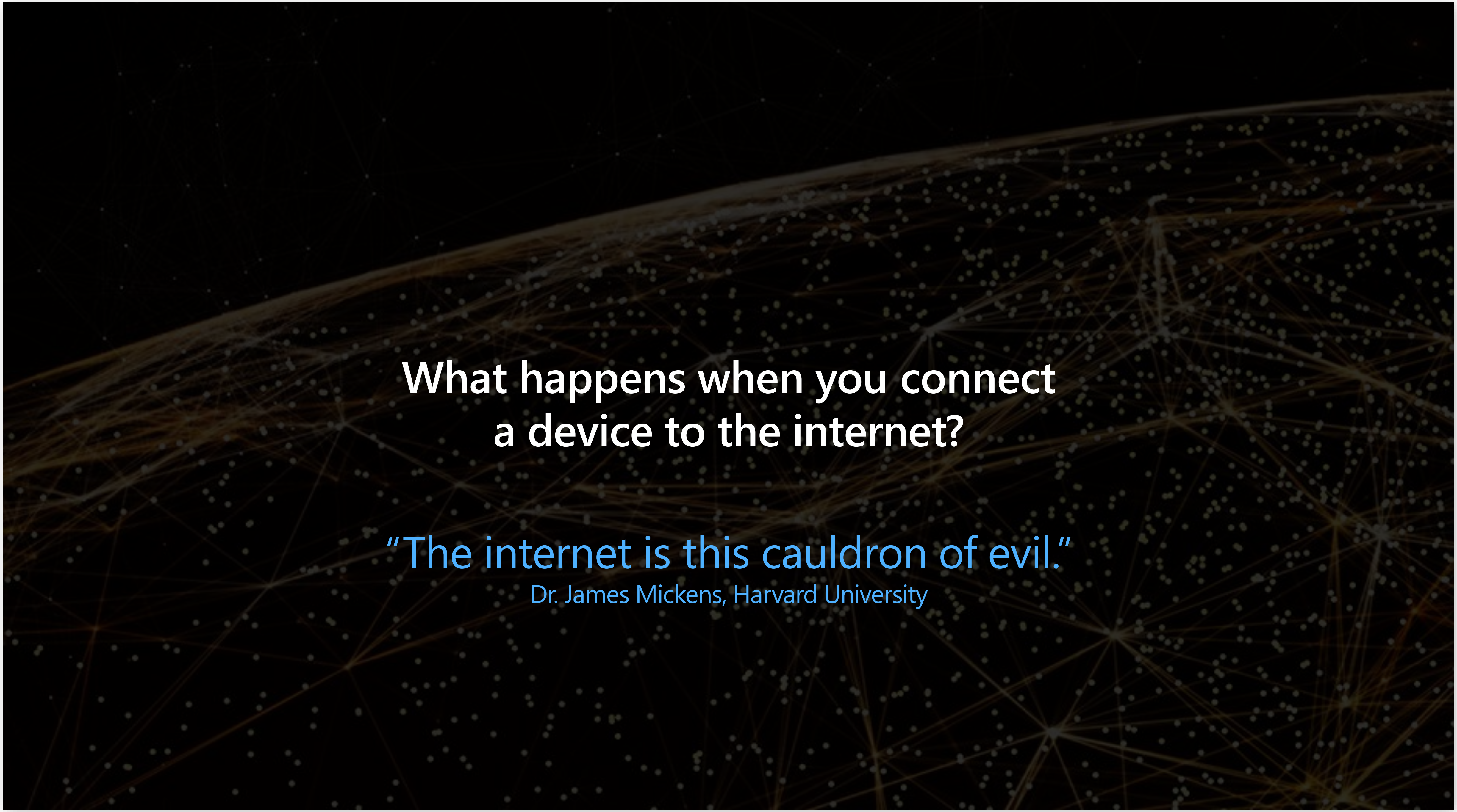
The Old Way

Melted ice cream

The New Way

Auto-diagnosis

Opportunity | Risk



What happens when you connect a device to the internet?

“The internet is this cauldron of evil.”

Dr. James Mickens, Harvard University

“Ransomware attacks will target more IoT devices in 2018”

“Huge IoT botnet may be used for Ukraine attack”

“Industrial IoT to equip new era of corporate intruders coming in through devices”

“When smart gadgets spy on you: Your home life is less private than you think”

“Hacking these IoT baby monitors is child’s play, researchers reveal”

“Security experts warn of dangers of connected home devices”

“Hackers infect 500,000 consumer routers all over the world with malware”

“Your smart fridge may kill you: The dark side of IoT”

“The Lurking Danger of Medical Device Hackers”

“Why the KRACK Wi-Fi mess will take decades to clean up

“Hacking critical infrastructure via a vending machine? The IOT reality”

“Protecting Your Family: The Internet of Things Gives Hackers Creepy New Options”

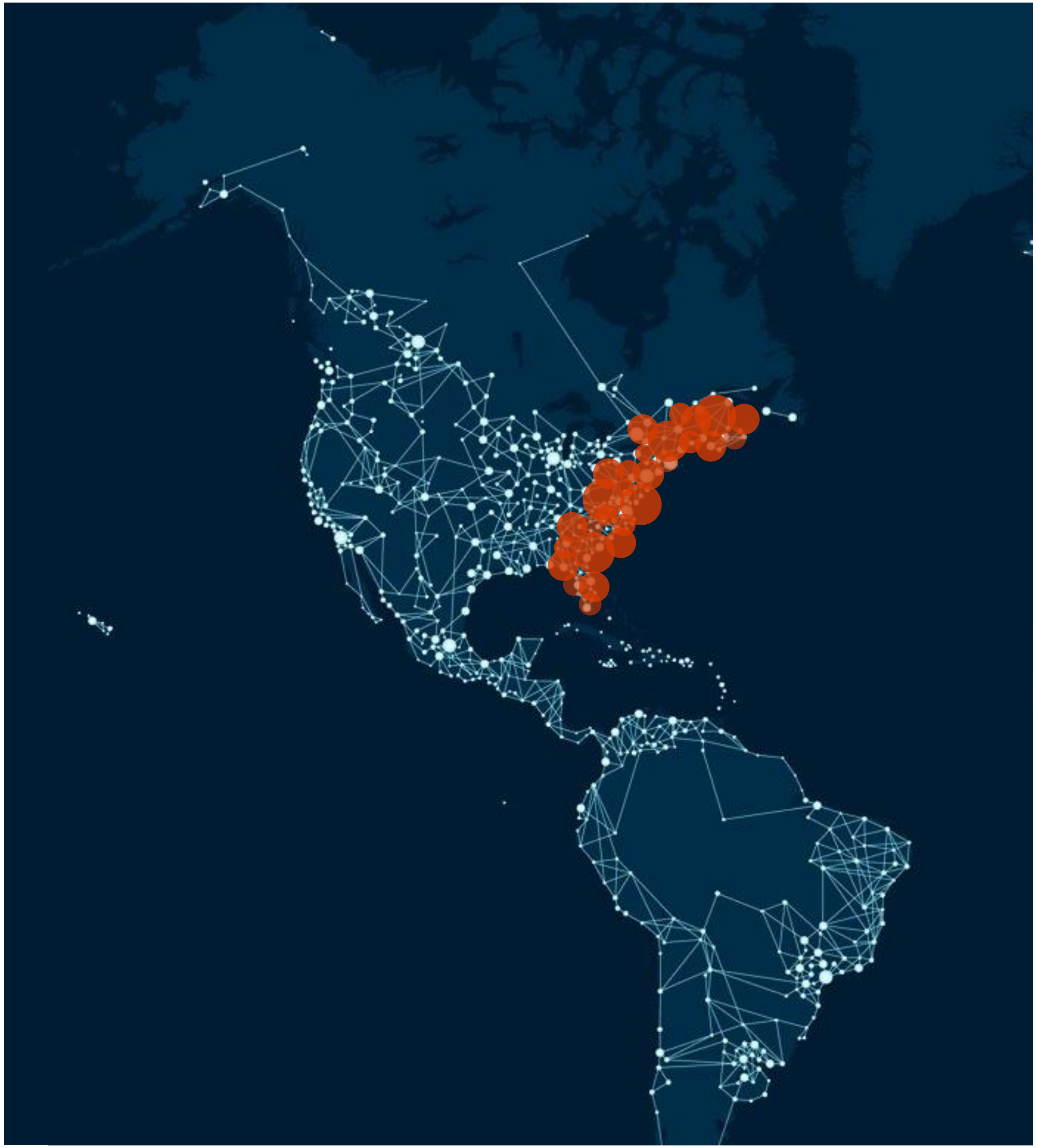
Mirai Botnet attack

Everyday devices are used to launch an attack that takes down the internet for a day

100k devices

Exploited a well known weakness

No early detection, no remote update



Building a highly-secured device is difficult and costly.

Design and build a holistic solution

You're only as secure as your weakest link.

You must have the technical expertise to stitch disparate security components into an gap-free, end-to-end solution.

Recognize and mitigate emerging threats

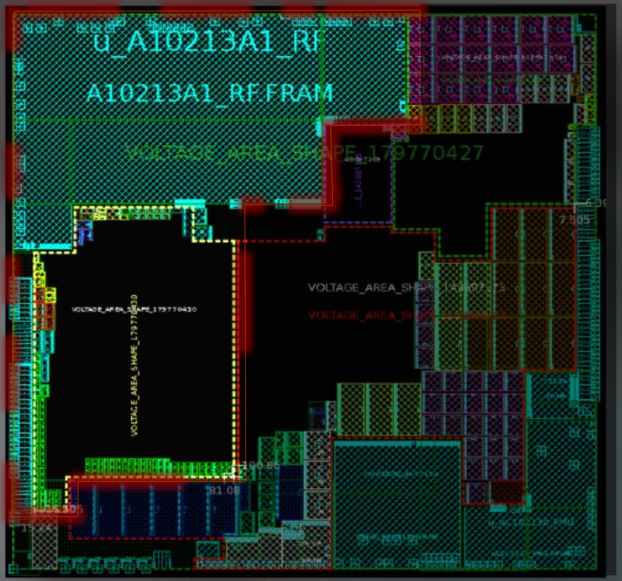
Threats evolve over time.

You must have the ongoing security expertise to identify and create the updates needed to mitigate new threats as they emerge.

Distribute and apply updates on a global scale

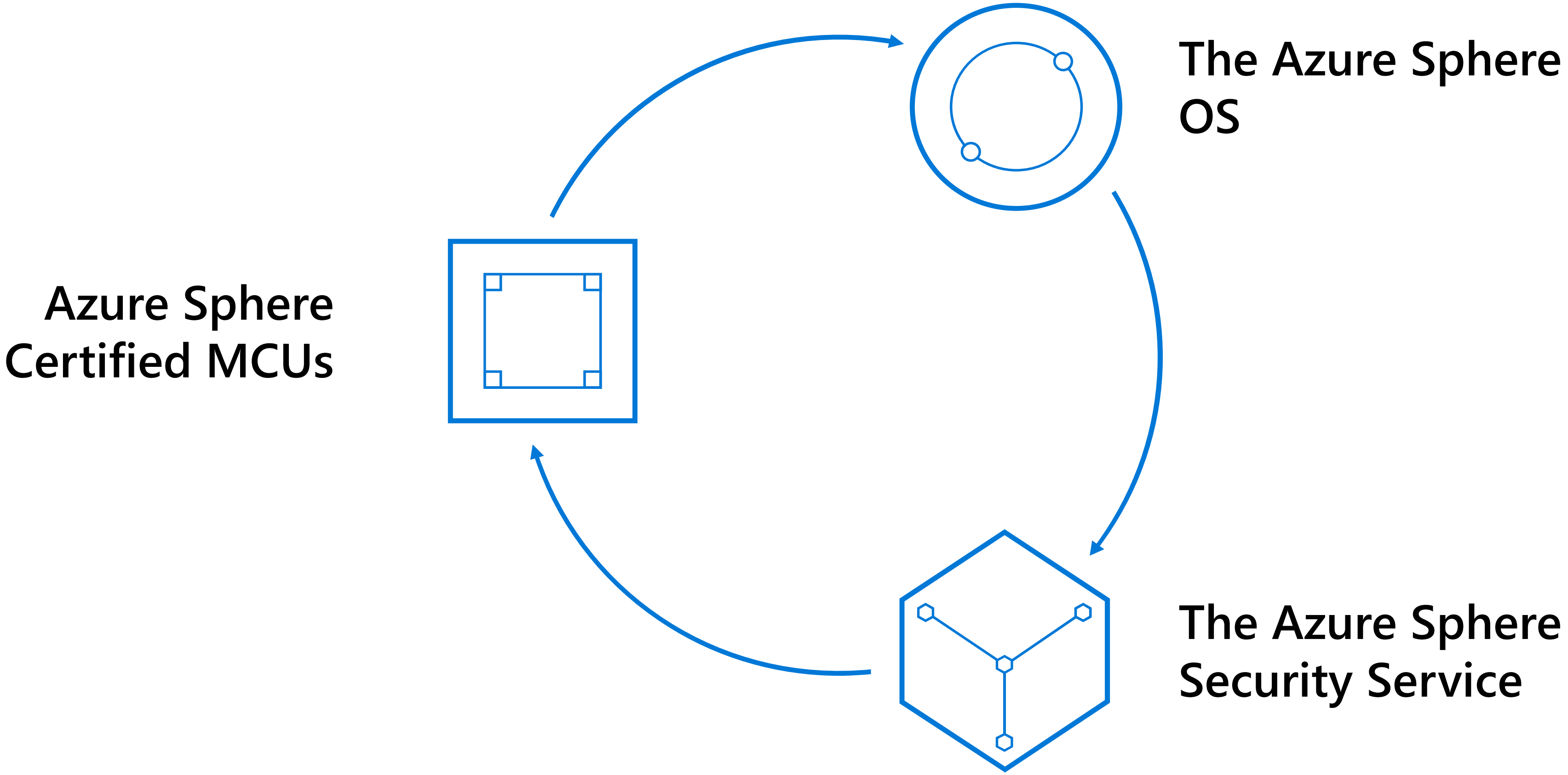
Update efficiency is critical.

You must have the infrastructure, logistics and operational excellence to deliver and deploy updates globally to your entire fleet of devices in hours.



How can we secure the 9 BILLION new MCU-based devices built and deployed every year?

Azure Sphere is an end-to-end solution for securing MCU powered devices



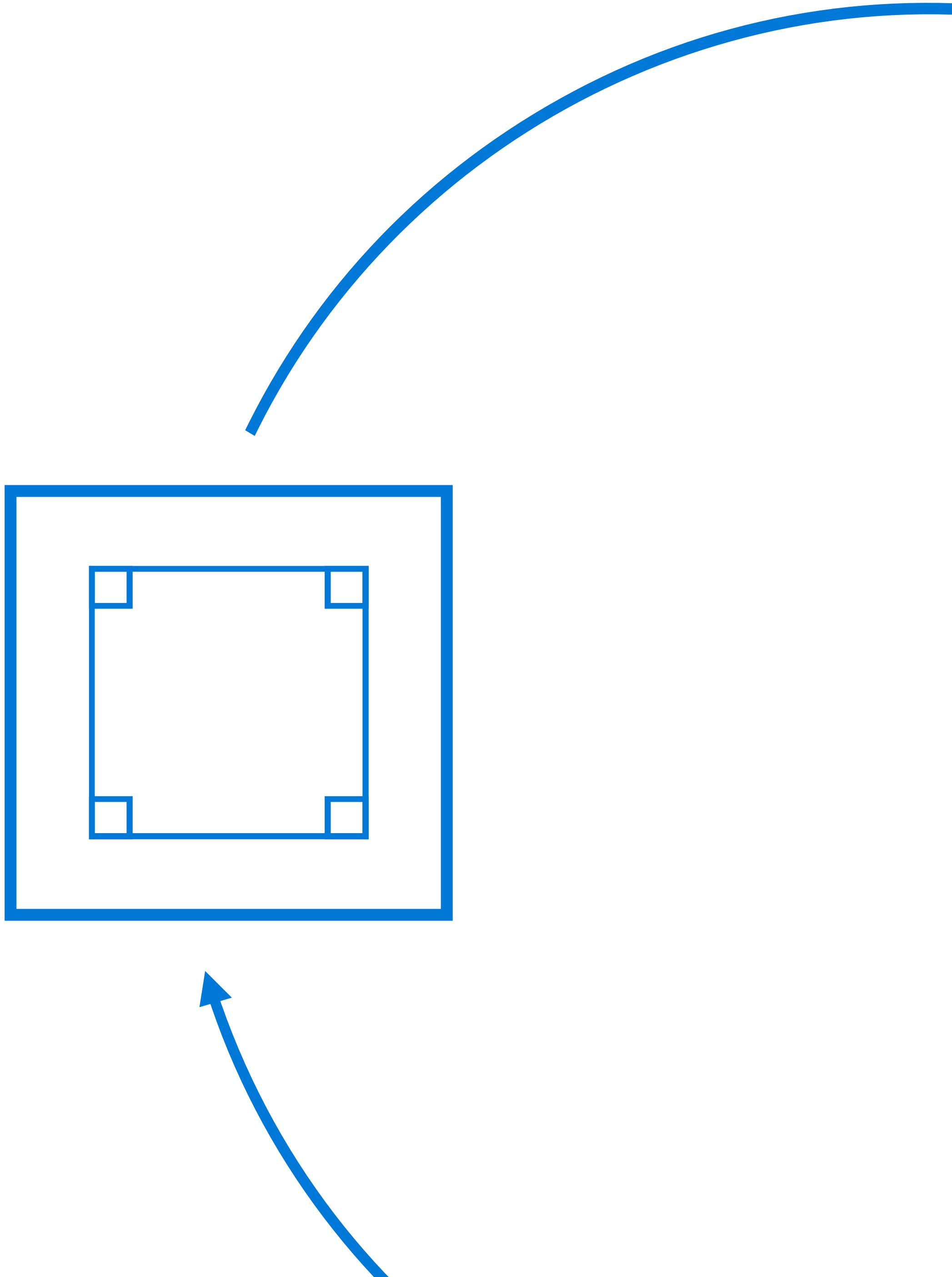
Azure Sphere Certified MCUs

The Azure Sphere OS

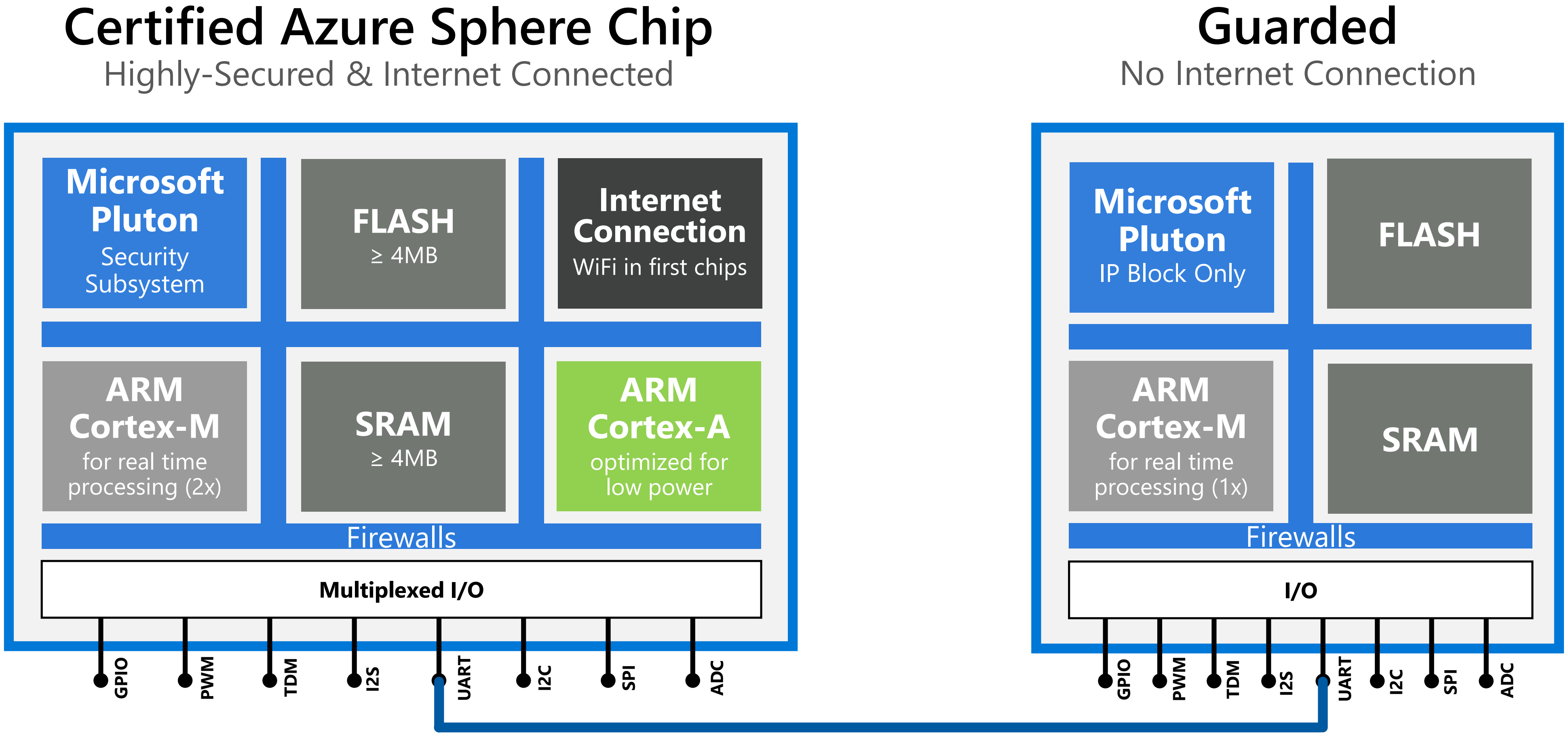
The Azure Sphere Security Service

Azure Sphere Certified Chips

with a built-in **hardware root of trust** created from Microsoft’s learnings securing three generations of Xbox consoles.



Azure Sphere defines two templates for secured chips



SECURED with full Pluton Security Subsystem

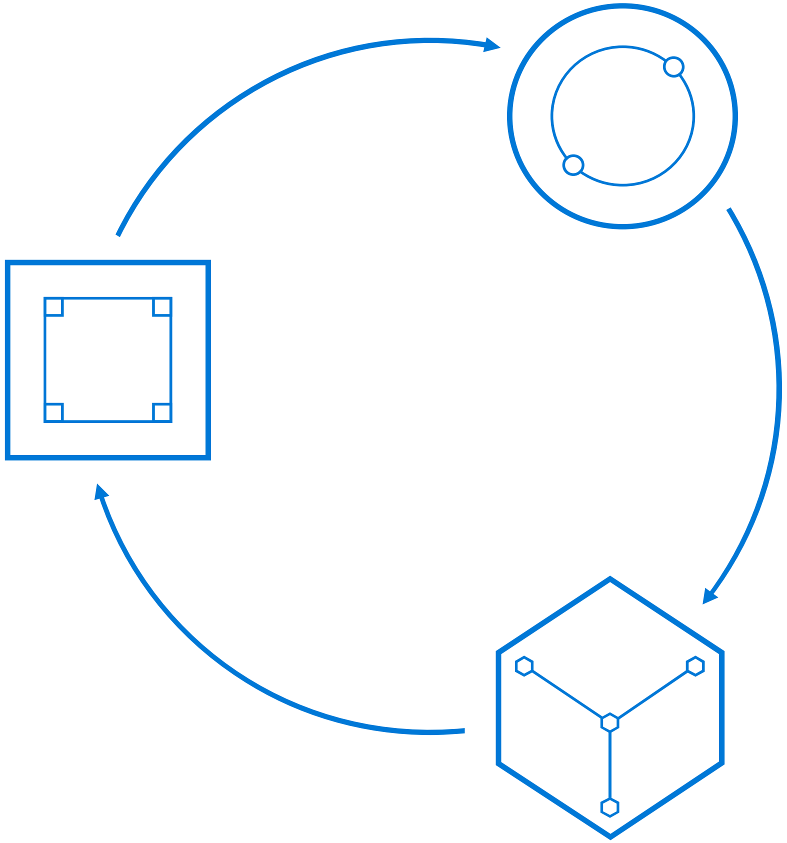
CONNECTED with built-in Internet networking

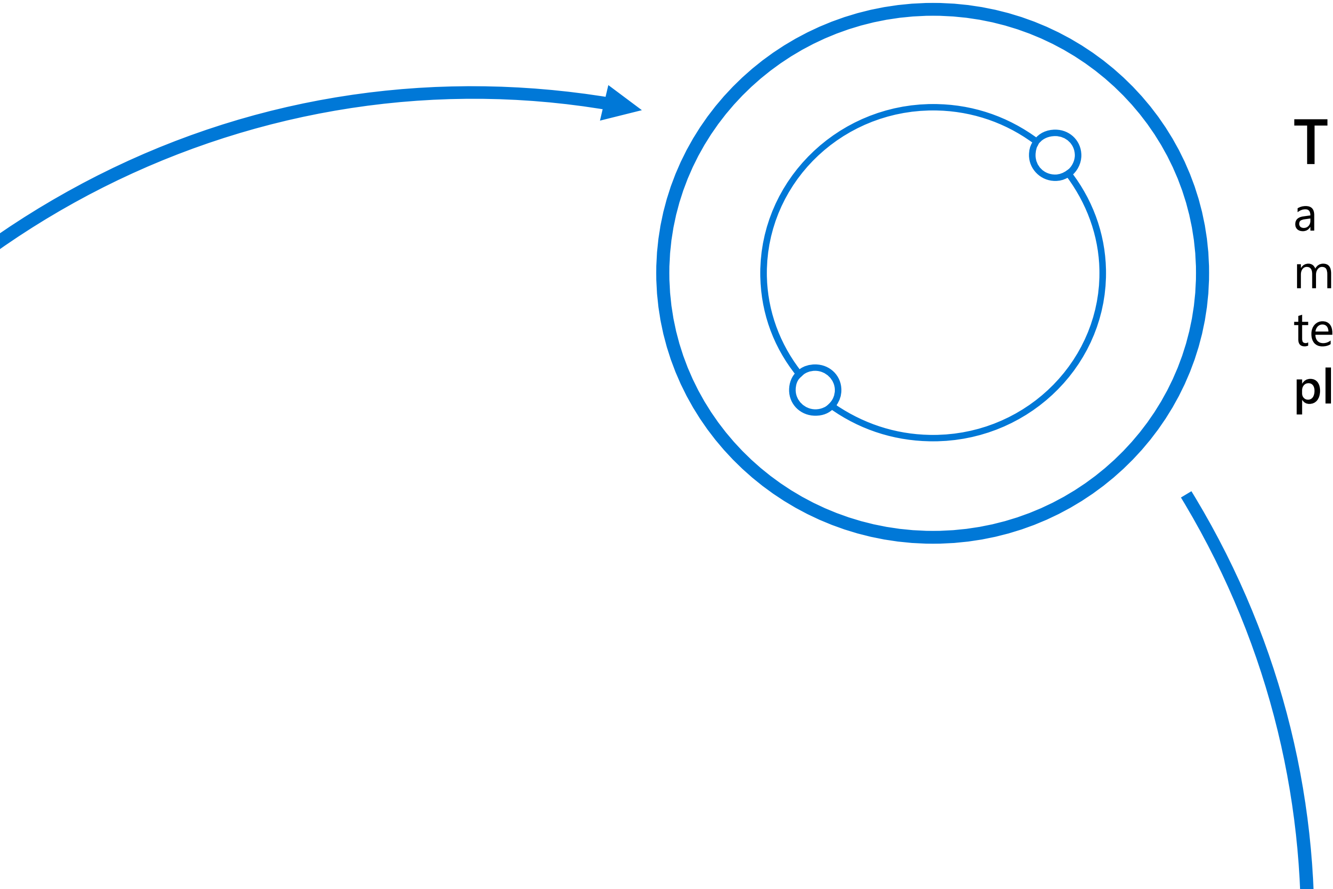
CROSSOVER rich processing brought to MCUs

LOCKED with Pluton IP block

GUARDED by full Azure Sphere Chip

HARD-WIRED within device





The Azure Sphere OS

a multi-layer defense-in-depth OS that merges the best of Microsoft and OSS technologies to create **a trustworthy platform** for new IoT experiences

The Azure Sphere OS is optimized for IoT, security, and agility

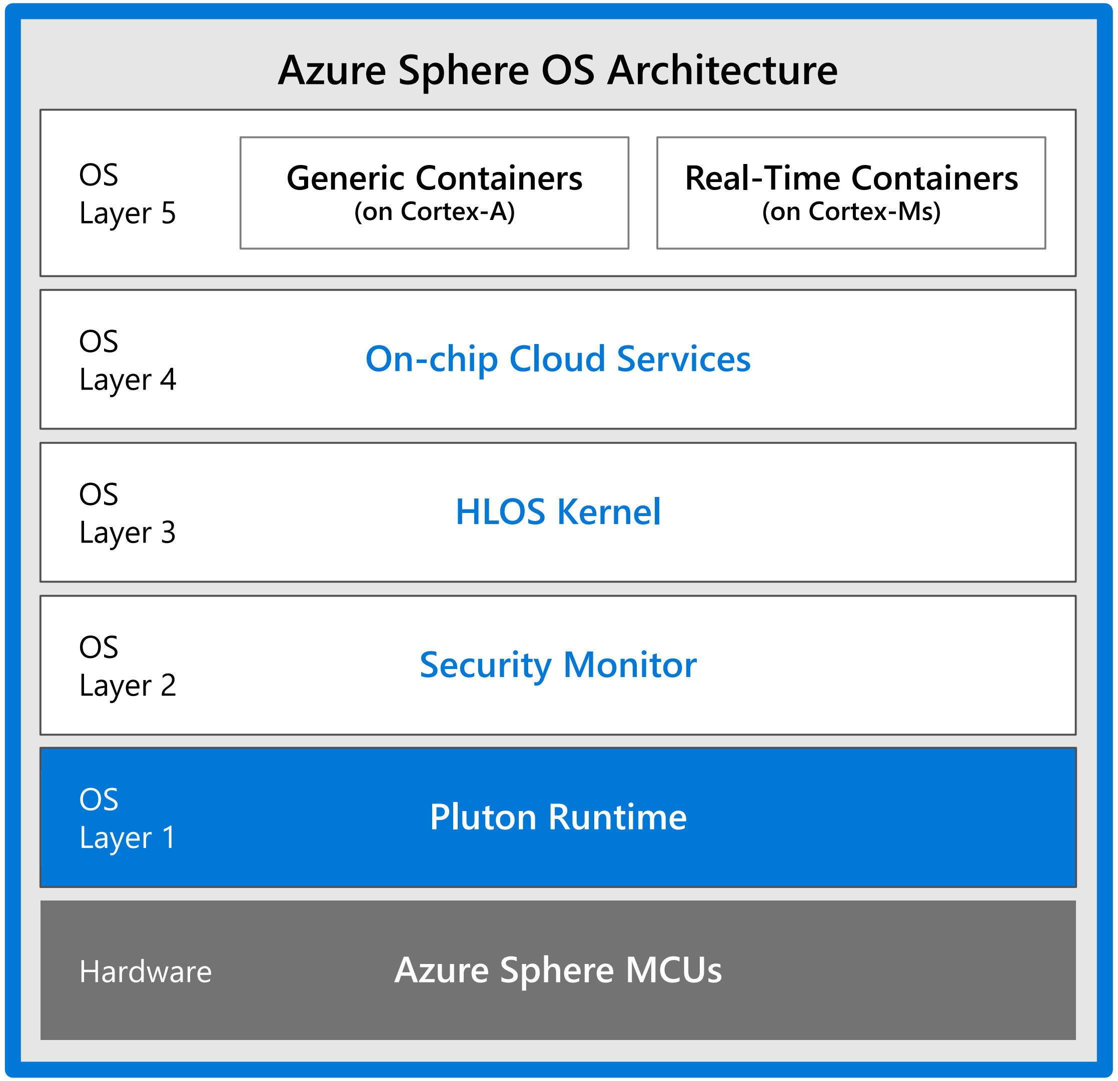
Secure Application Containers
Compartmentalize code for agility, robustness & security

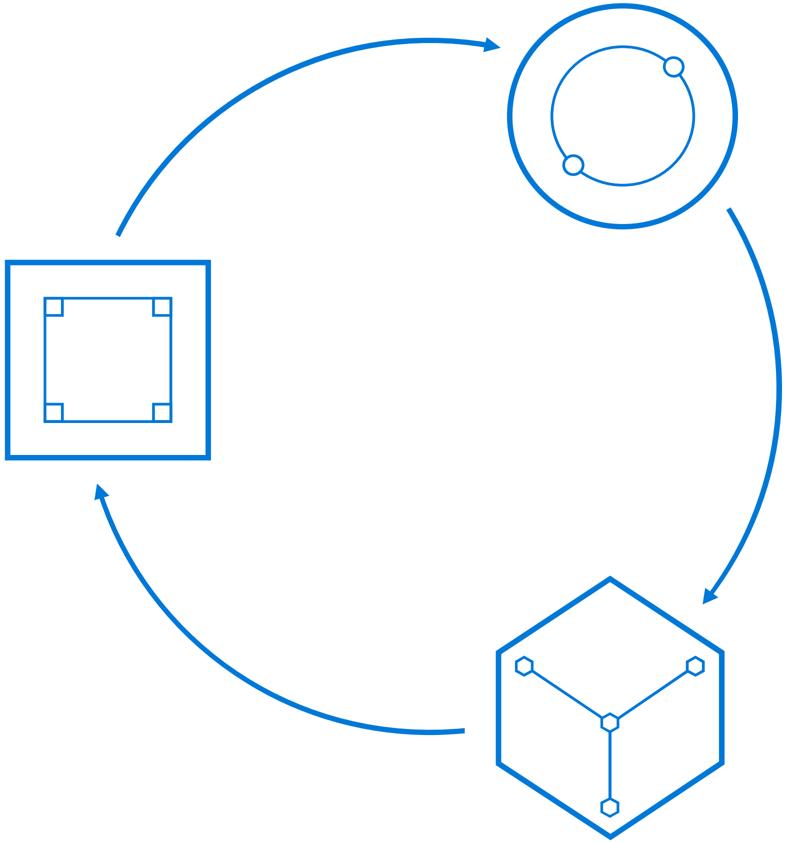
On-chip Cloud Services
Provide update, authentication, and connectivity

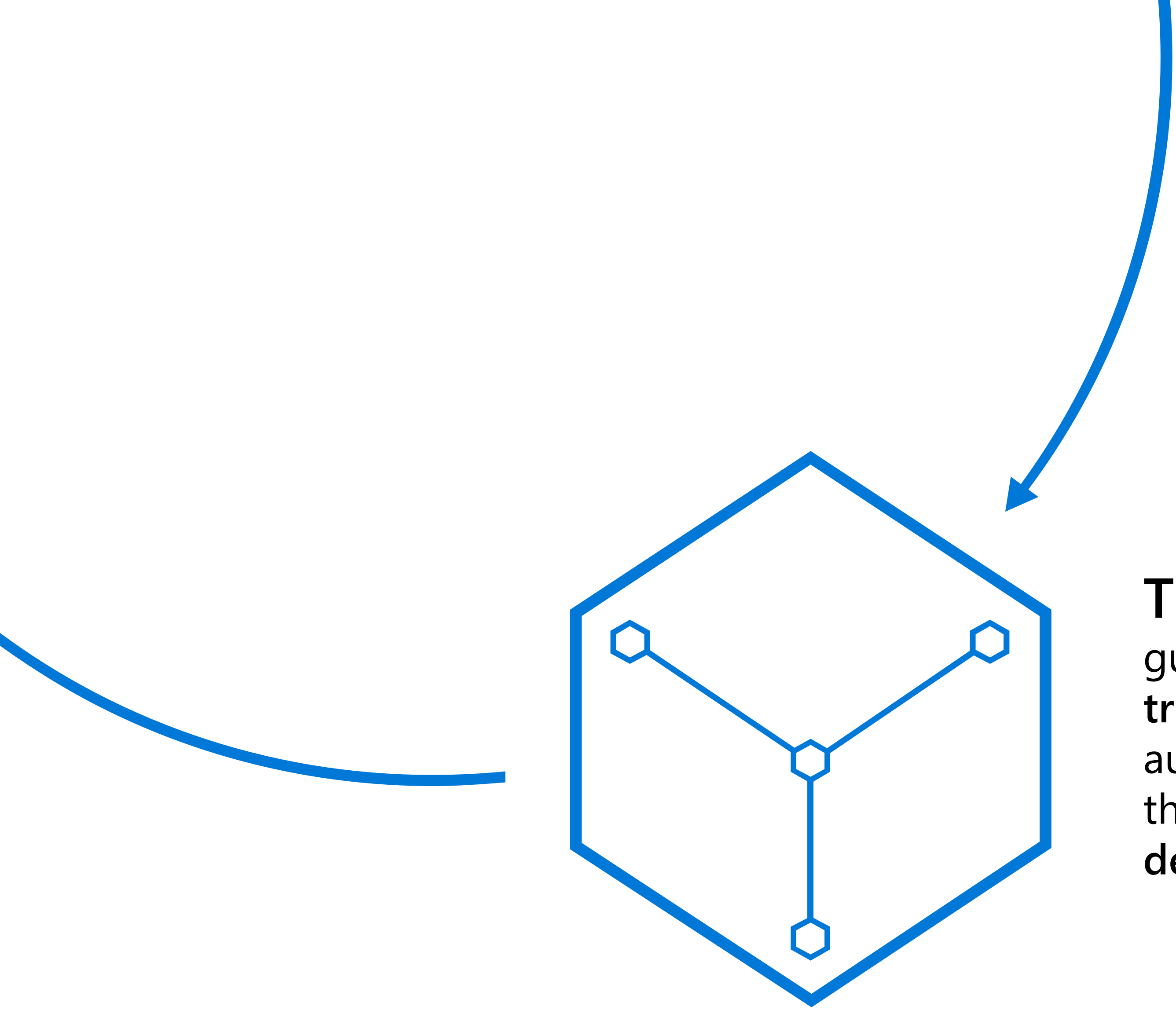
Custom Linux kernel
Empowers agile silicon evolution and reuse of code

Security Monitor
Guards integrity and access to hardware resources

Pluton Runtime
Controls processing cores and access to crypto ops







The Azure Sphere Security Service

guards every Azure Sphere device; it **brokers trust** for connectivity through certificate based authentication, **detects emerging threats** through online failure reporting, and **renews device security** through software updates.

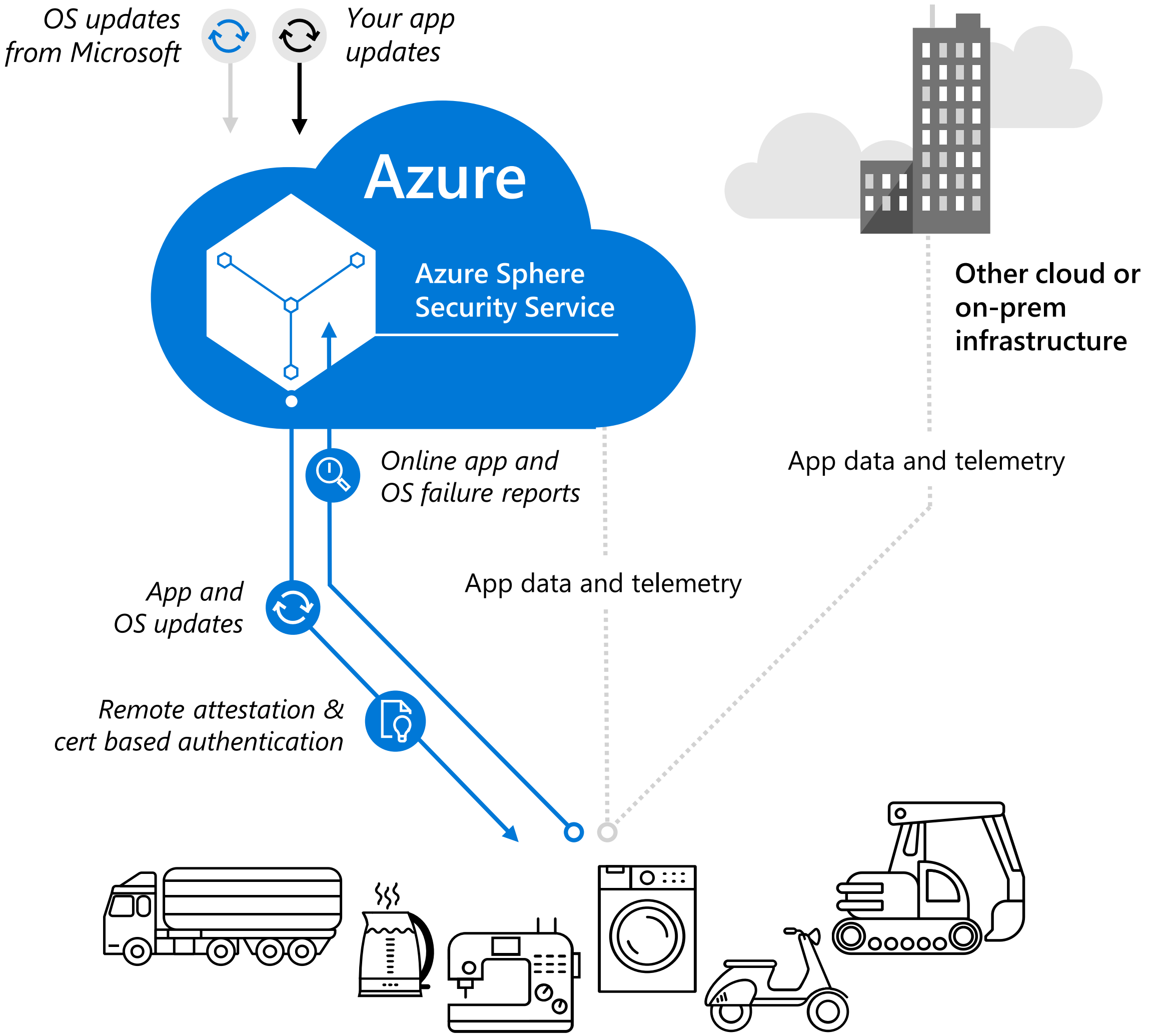
The Azure Sphere Security Service connects and protects every Azure Sphere device

Protects your devices and your customers with certificate-based authentication of all communication

Detects emerging security threats through automated processing of on-device failures

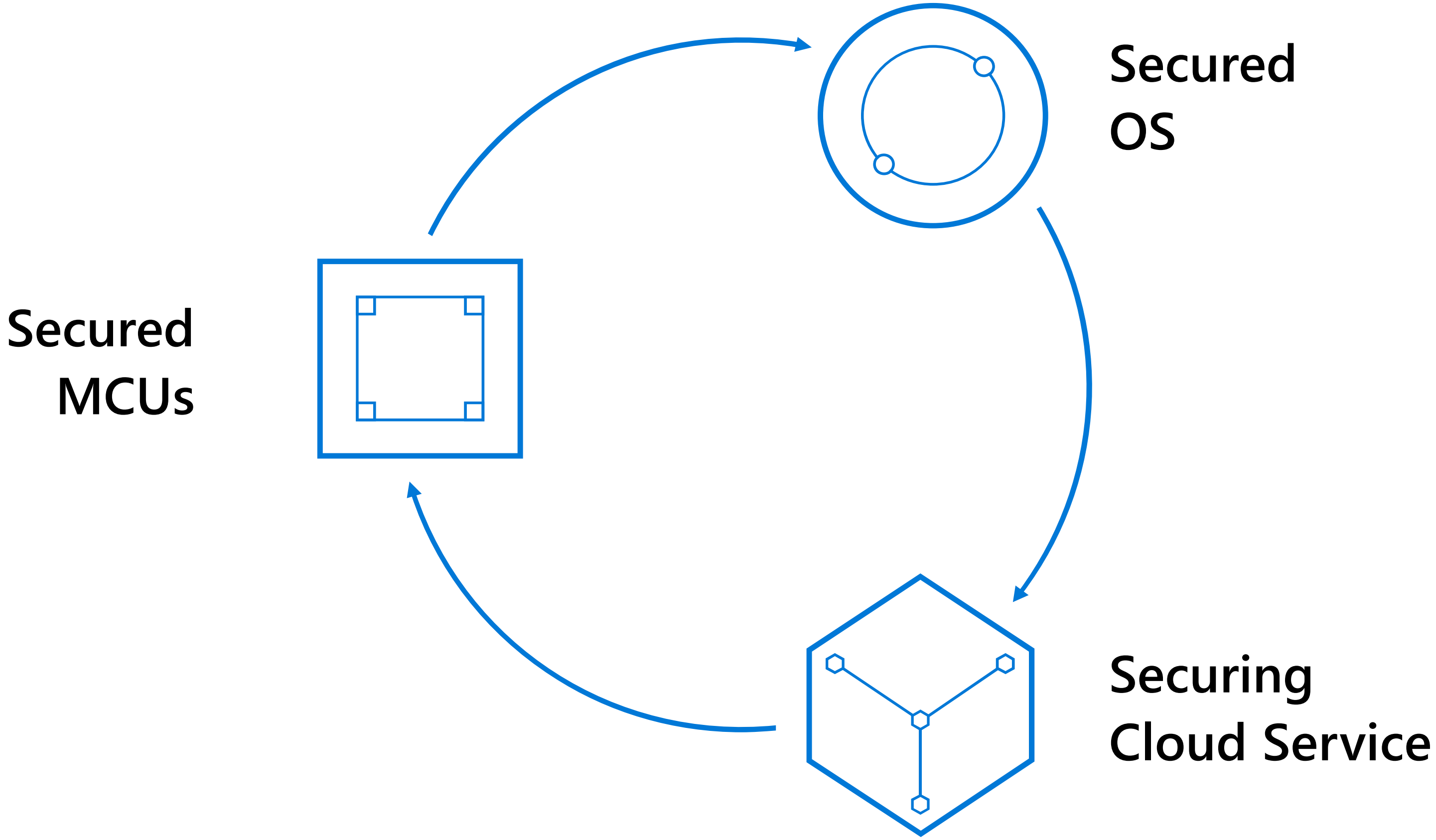
Responds to threats with fully automated on-device updates of OS

Allows for easy deployment of software updates to Azure Sphere powered devices



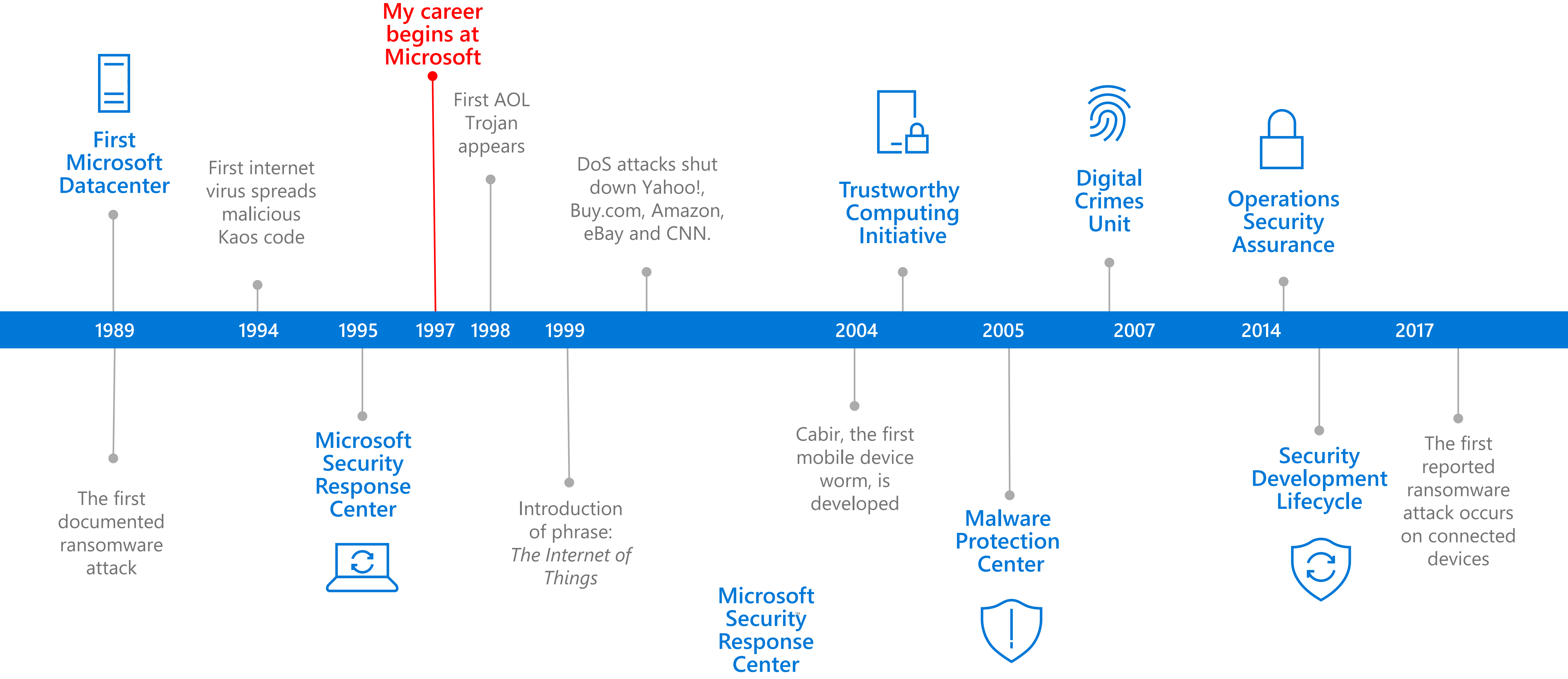
OS updates from Microsoft
Your app updates
Azure
Azure Sphere Security Service
Other cloud or on-prem infrastructure
Online app and OS failure reports
App data and telemetry
App data and telemetry
App and OS updates
Remote attestation & cert based authentication

Device Security is like a stool; it requires three legs:



How do we think about device security?

Microsoft has more than 25 years experience protecting customers and their devices.



1989

First Microsoft Datacenter

The first documented ransomware attack

1994

First internet virus spreads malicious Kaos code

1995

Microsoft Security Response Center

1997

My career begins at Microsoft

1998

First AOL Trojan appears

1999

Introduction of phrase: *The Internet of Things*

DoS attacks shut down Yahoo!, Buy.com, Amazon, eBay and CNN.

Microsoft Security Response Center

2004

Cabir, the first mobile device worm, is developed

Trustworthy Computing Initiative

2005

Malware Protection Center

2007

Digital Crimes Unit

2014

Operations Security Assurance

Security Development Lifecycle

2017

The first reported ransomware attack occurs on connected devices

SECURITY IS FOUNDATIONAL

It must be built in from the beginning.

The 7 properties of highly secured devices

Is your device highly secured or does it just have some security features?

Hardware Root of Trust

Is your device's identity and software integrity secured by hardware?

Defense in Depth

Does your device remain protected if one of its security mechanisms is defeated?

Small Trusted Computing Base

Is your device's security-enforcement code protected from bugs in other code?

Dynamic Compartments

Can your device's security enforcement improve after deployment?

Certificate-Based Authentication

Does your device use certificates instead of passwords for authentication?

Failure Reporting

Does your device report back failures and anomalies?

Renewable Security

Does your device's software update automatically?

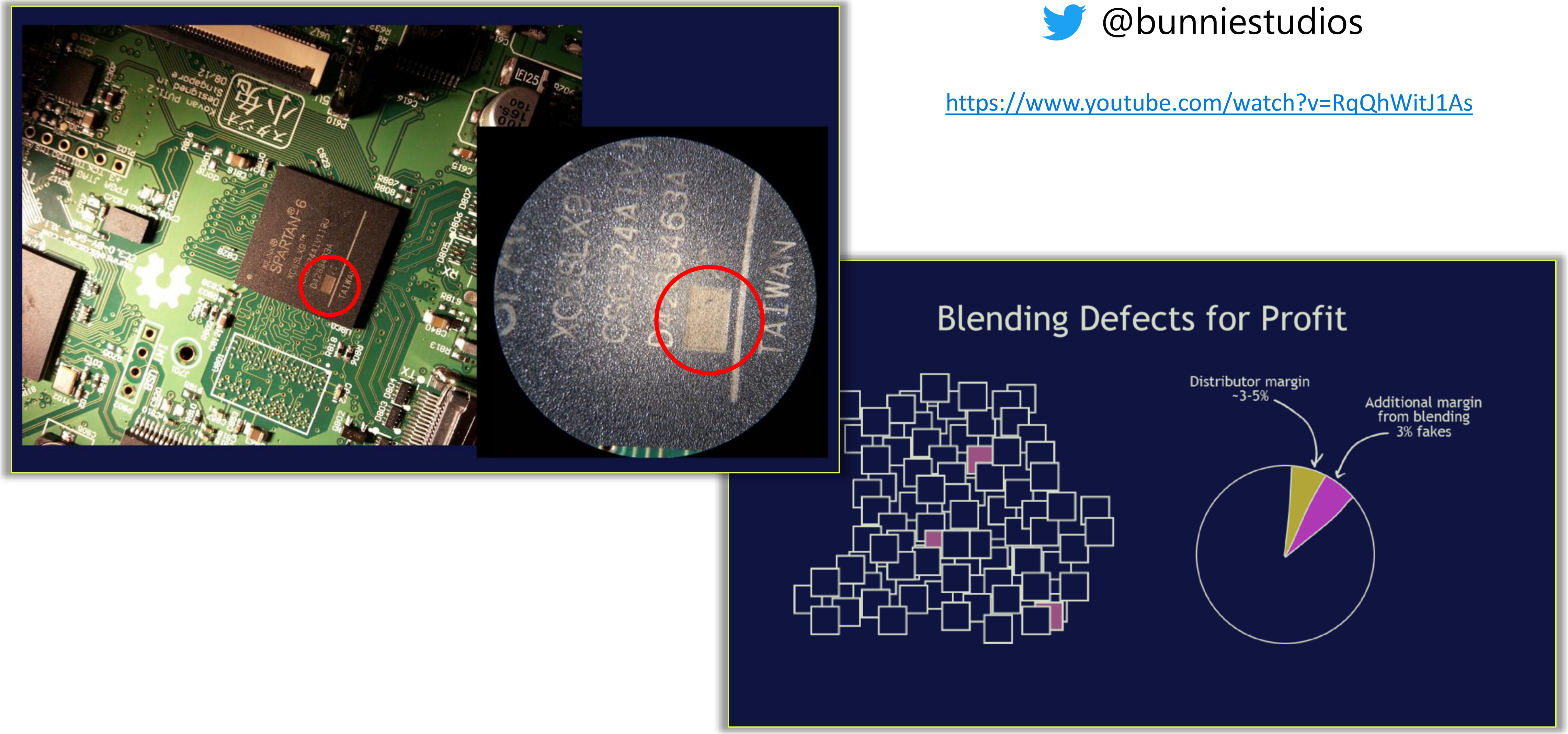
https://aka.ms/7properties

“Supply chains are not friendly territory.”

- Andrew “bunnie” Huang, *BlueHat IL 2019*

@bunniestudios

https://www.youtube.com/watch?v=RqQhWitJ1As



Blending Defects for Profit

Some properties depend only on hardware support

Hardware
Root of Trust

Hardware Root of Trust

Unforgeable cryptographic keys generated and protected by hardware

- Hardware to **protect device identity**
- Hardware to **secure software boot**
- Hardware to **attest system integrity**

Some properties depend on hardware and software

Defense in Depth

Dynamic Compartments

Small Trusted Computing Base

Dynamic Compartments

Internal barriers limit the reach of any single failure

- Hardware to **create barriers**
- Software to **configure into compartments**

Some properties depend on hardware, software and cloud

Certificate-Based Authentication

Failure Reporting

Renewable Security

Renewable Security

Device security renewed to overcome emerging and evolving threats

- Cloud to **provide updates**
- Software to **apply updates**
- Hardware to **prevent rollbacks**

Meeting the 7 properties is difficult and costly

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Context Matters: Hackers attack casino

Attackers gain access to casino database through fish tank

Entry point was a connected thermometer

Once in, other vulnerabilities were exploited

Gained access to high-roller database

Opportunity | Risk | Responsibility

Let’s secure the future.

SECURED FROM THE SILICON UP

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